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12/27/2012

Operation of the RTD Spooler Application

Introduction

The RTD Spooler is an instrument on which three RTD's are mounted on a printed circuit board, approximately 9" (~23 cm) apart. This circuit board is hung from a chain-like loop. A stepper motor is used to vertically raise and lower the circuit board which allows the RTD's to sample the vertical temperature profile of the LAPD cryostat. At present there are two of these spoolers in LAPD, one near the center axis of the cryostat, the other offset radially. The stepper motors are controlled by a commercial stepper driver (Surestep DRV 4850). The drivers are in turn controlled by a purpose-built LabVIEW application program that set up the drive parameters, load in the number of steps to move, move, and then wait as the temperature data are recorded at that position, then move to the next position. When the RTD's reach their extreme vertical position in the LAPD tank, the direction of motion is reversed, and measurements are taken at each of the previous positions except with the pc board movement in the opposite direction. The application will continuously cycle until halted at the application level.

The idea is to measure the temperature difference as a function of vertical height. Since the RTD's on a single board move, each RTD samples the vertical profile, and the absolute calibration of each RTD plays little to no role in a precise determination of the profile. The RTD's are measured using a Lakeshore 218E 8 Channel Temperature Monitor.

Hardware Setup:

As of this writing, the stand-alone LabVIEW application and its runtime engine (based on LV 8.6) was installed on a laptop computer running Windows XP. The laptop is plugged into a dock which provides 4 USB ports. These ports are connected to USB-RS232 Serial converters. Drivers for these converters are presumably installed on the laptop. With this setup, the three controlled devices (two Surestep DRV4850 stepper drivers, and the Lakeshore 218E Temperature Monitor) appear as three serial devices connected to the LabVIEW Application. The RS232 setup itself is done within the LabVIEW application and no other preparation is needed from the user—except to make sure they are connected to the relevant USB ports. Figure 1 shows a picture of the front panel and the USB ports that are assigned.

The two Surestep DRV4850 drivers are wired to the stepper motors. Each unit requires two power inputs, one that controls the logic of the unit, the second that supplies the current to the stepper motors. The logic power is supplied by a unit nearby the two drivers. The stepper motor current supply is a NIM module located in a NIM bin that also houses the Purity Monitor electronics. This was made this way so that the power can be turned off the Stepper motors when the Purity Monitors are running. The reason is that

the Stepper Driver supplies the motor power using a PWM circuit that is running at 20kHz. This generates a considerable pickup on the Purity Monitor electronics, and also the Long Bo TPC electronics. Also a logic signal is generated here that triggers a "Motor Enable" bit in each of the Surestep DRV4850 drivers. As it turns out, this bit also disables the motor PWM power from the driver, so there is a bit of redundancy here. It should also be noted, that there is a switch on the NIM module that manually removes the motor current power to the DRC4850 drivers.

Before Starting:

Before attempting to start the RTD Spooler setup, check that the switch that manually turns off the motor current power is positioned in the automatic mode. Also be sure that it is acceptable to do this (if power is disabled) by checking with the Purity Monitor and/or TPC operations.

Next step is to check that the remote drive on the IFIX server (PPD111956 is mounted on the laptop PC. To do this, navigate via the XP Start menu to "My Computer". When the window pops up, you want to see that 'Incoming on 'PPD-111956' is mounted. If it isn't it can be mounted by using your Kerberos principle.

Running the RTD Spooler

If not already opened, the application can be opened and run by clicking the mouse on the RTDSpooler link located on the laptop desktop. This will launch and run the standalone LabVIEW application. If the front panel is already on the display, simply click the "start arrow", which is the first icon on the third row from the top of the window menu bar (see Figure 1).

What you will see is the same front panel as is shown in Figure 1. If the spoolers are not at their starting positions—at the top of LAPD with their appropriate limit switches on, they will be automatically moved to that location. Typically they will not be at the starting locations (unless one stopped them that way the last time the application was run which probably isn't likely).

The two setups move asynchronously of each other. Whichever one reaches the top first will start to make measurements. At each point, 2 sets of measurements of the 3 RTD's on a spooler will be taken and written both to the IFIX server and also locally on the laptop. Each of the Spoolers has its own file.

If left alone, the application will automatically move the spooler to the next fixed location until it hits the bottom limit switch, or the last position set. When that position is reached, the system reverses direction and measures the same positions on the way back up. This will continue to alternate directions until someone clicks on the "STOP ALL" button. When this happens, the application bails out of all the current program loops, then disables the motor currents, and exits. It should be noted that it may take up to a minute or so to achieve this exit. A flashing yellow indicator shows that it is trying to stop.

Other details:

The control of the stepper motors and RTD measurements is contained on the "spooler control" tab of the application window. For the most part these parameters should be left as is. One parameter that might be changed is the "Delay before read (s)" whose current default value is 30s. What this does is wait 30 seconds after a position change before commencing measurements on the RTDs. This can be increased (or decreased) if desired, but note that it needs to be done on each of the two spoolers.

A 2D plotting routing was added to the application. The total of 6 RTD temperatures vs. Step count are shown on the second tab of the LV application. At this time, it does not take into account that the two spoolers don't start from the same vertical height position, or that the individual RTD's on a particular pcb are ~23cm apart from each other. A graphic of this tab is shown in Figure 2 (This figure doesn't show any plotted data due to my inability to get a color graphic off the laptop PC.)

Dictionary of Parameter Names

lakeshore com port : (default COM7) —the physical port that LabView uses to talk to the lakeshore device. Both spoolers use different channels of the same LakeShore 218E (see RTDx Ports variable below for the actual channel values)

motor 1 com port : (default COM8)—the physical port that LabView uses to talk to the SureStep DRV4850 Stepper motor drive for spooler #1.

motor 2 com port : (default COM6)—the physical port that LabView uses to talk to the SureStep DRV4850 Stepper motor driver for spooler #2.

RTD1 Ports : (default 1,2,3) Channels on Lakeshore 218E used by RTD's on Spooler #1
RTD2 Ports : (default 5,6,7) Channels on Lakeshore 218E used by RTD's on Spooler #2

N Measurements: (default 3) number of measurements made on each RTD for each spooler position

Milliseconds between measurements: (default 500ms) time between each measurement of an RTD when at one position.

Average temp: (readback) average of the N measurements from a RTD (most likely the third RTD of the three measured)

Temp: (readback) the last of the N measurements from a RTD (also most likely the third RTD of the 3 read).

Complete cycles: (readback) How many down and up cycles that have been made of a spooler.

accel, decel, velocity: (default 1.0 revolutions/s^2, 1.0 revolutions/s^2, 0.2 revolution/s) acceleration, deceleration, and velocity of stepper motor shaft.

feed to bottom: (default #1 -500000, #2 +500000) Number of steps between limit switches. Sign represents direction (+ cw or - ccw) that the stepper moves. (note to move Spooler upwards, multiply this number by -1).

feed to next midpoint: (default #1 -20500, #2 17200) Number of steps between each measurement position.

N spooler stops: (default 21) Number of vertical positions.

Delay before read (s) : (default 30s) How long to pause after a move before starting to measure the RTD temperatures.

Meas. pos. : (readback) current vertical position. Note this is a calculated position based on zero being the initial starting location and simply adding the "feed to next midpoint". It does not use the stepper step counter, or any type of encoder.

Note that this application is not running within an actual LabVIEW developmental environment, but is only a compiled version of the application. It is lacking the diagrams and much of the debugging that you have in the development system.

To edit the original application, you will need a LabVIEW 8.6 (or later) Development system and access to the original files. If you want to make a new runtime version, you need the Professional version or someone who has access to that version.

Acknowledgements

This LabVIEW application referenced in this note is a modification of the application originally written of Chad Johnson.

Figure 1: Snapshot of RTD Spooler Control Panel

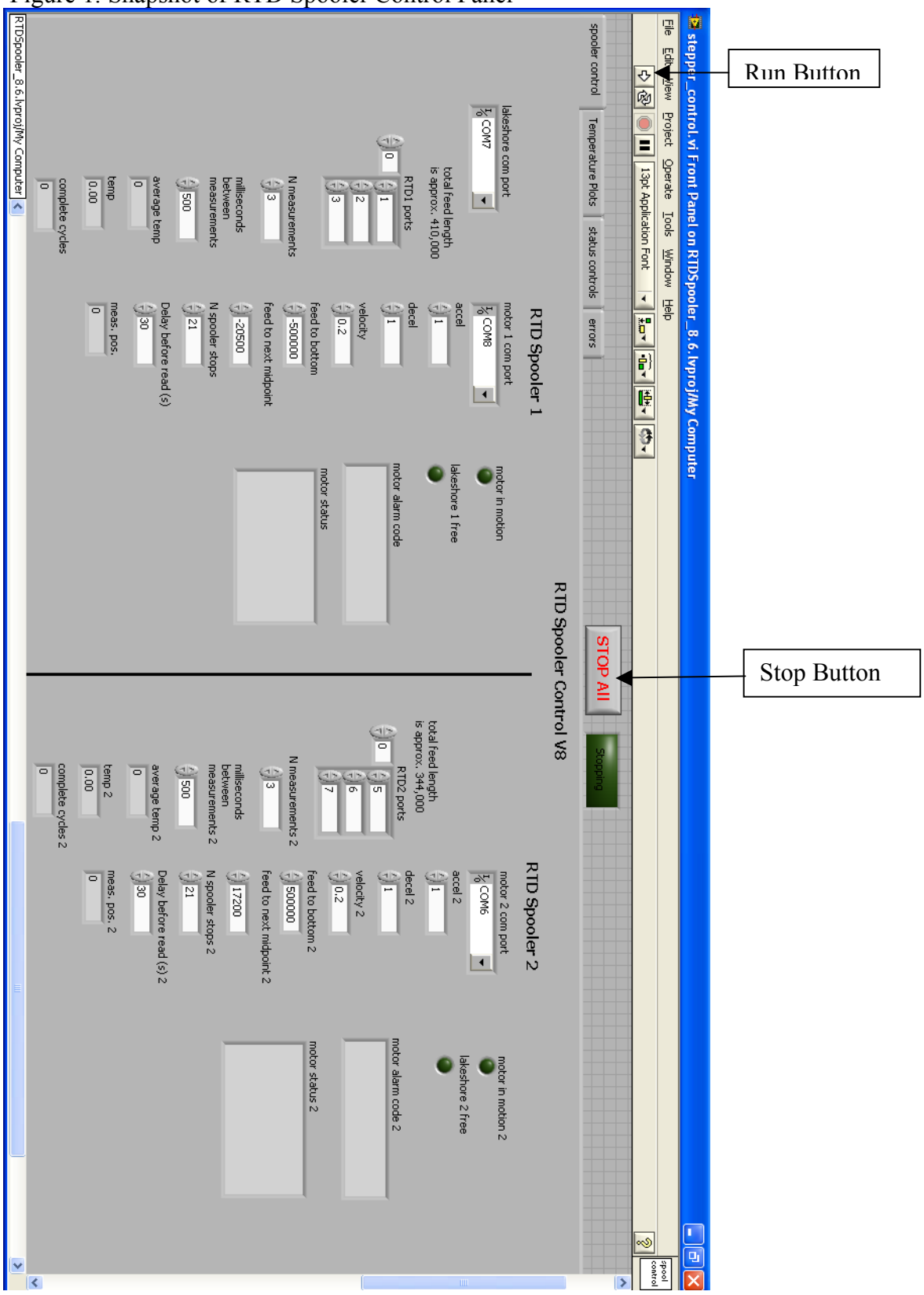

Figure 2: Snapshot of Temperature Plots Tab